METHODS FOR OBTAINING PRINT AND OTHER HAND CHARACTERISTIC INFORMATION USING A NON-PLANAR PRISM

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CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 60/431,240, filed December 6, 2002, and U.S. Provisional Application No. 60/491,537, filed August 1, 2003, both of which are incorporated herein by reference in their entireties.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The present invention pertains to biometric imaging technology, and in particular, to live scanning of prints.

Background Art

[0003] Biometrics is a science involving the analysis of biological characteristics. Biometric imaging captures a measurable characteristic of a human being for identity and other related purposes. Print capture and recognition is an important biometric technology. Law enforcement, banking, voting, and other industries increasingly rely upon prints as a biometric to store, recognize or verify identity. Generally, a biometric is a measurable, physical characteristic or personal behavior trait used to recognize the identity, or verify the claimed identity, of a person who has a biometric reference template (e.g., data that represents a biometric measurement) on file.

[0004] Biometric imaging systems may include, but are not limited to, print imaging systems. Print imaging systems can capture images of prints on thumbs, fingers, palms, toes, feet, and/or hands. Such print imaging systems

are also referred to as scanners or live scanners. Conventional live scanners use light to detect an image of a fingerprint and/or palm print. For example, one or more fingers or a palm are placed on a platen. An illumination source illuminates the underside of the platen. An image representative of valleys, ridges, or other characteristics of a fingerprint or a palm print is then detected by an image sensor, such as a solid-state camera.

[0005] One problem with conventional palm live scanner systems is that a palm naturally curves, while a typical platen has a flat planar surface upon which a palm is placed. Thus, there is a chance that not all portions of the palm print will be imaged during scanning. If this occurs, biometric information can be lost.

[0006] Also, in many live scanners, increasing the surface area of a flat platen requires a significant increase in the size of a camera being used to detect images on the platen. Large area cameras or sets of cameras can dramatically increase cost and complexity. As a result, the size of the surface area of a flat platen is limited in many live scanners to a size of an average palm or smaller.

[0007] Therefore, what is needed is a method for capturing images representing biometric data of a user that includes using a prism shaped to better conform to a palm of the user's hand.

BRIEF SUMMARY OF THE INVENTION

[0008] Embodiments of the present invention provide a method including at least the following steps. Totally internally reflecting light from a curved inside surface of a non-planar prism when a portion of a body of a person is received on a curved outside surface of the non-planar prism and scanning the curved inside surface with an scanning imaging device to capture the totally internally reflect light that forms an image on a detection device representative of print pattern data.

[0009] Another embodiment of the present invention provides a method including at least the following steps. Capturing an image representing a print pattern of a person interacting with a non-planar platen of a prism. Capturing calibration data. Generating image information including both the captured image and the captured calibration data. Storing the image information.

[0010] One advantage of using these methods can be that a print pattern, including thenar and hypothenar regions of the palm, interdigital regions, palm heel, palm pocket, writer's palm, and/or fingertips can be easily captured based on using a scanning imaging system that captures totally internally reflected light from an inside curved surface of a prism, which also receives a portion of a body of a person on an outside curved platen surface. The scanning imaging system includes an optical device that directs the totally internally reflected light as an image onto a detector.

[0011] Further embodiments, features, and advantages of the present inventions, as well as the structure and operation of the various embodiments of the present invention, are described in detail below with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS/FIGURES

[0012] The accompanying drawings, which are incorporated herein and form a part of the specification, illustrate the present invention and, together with the description, further serve to explain the principles of the invention and to enable a person skilled in the pertinent art to make and use the invention.

[0013] FIG. 1 shows a system for capturing biometric data according to an embodiment of the present invention.

[0014] FIG. 2 shows a local section of the system in FIG. 1 according to an embodiment of the present invention.

[0015] FIGS. 3-8 show various views of a prism according to an embodiment of the present invention.

[0016] FIGS. 9-11 show various views of image sectional areas on a prism according to various embodiments of the present invention.

[0017] FIGS. 12-13 show various prisms according to embodiments of the present invention.

[0018] FIG. 14 shows a material filled prism according to an embodiment of the present invention.

[0019] FIGS. 15-16 illustrate how a subject places one or both hands, respectively, on a prism according to various embodiments of the present invention.

[0020] FIGS. 17-19 show various parts of a hand used during image and biometric analysis according to embodiments of the present invention.

[0021] FIG. 20 shows an image of a print pattern of writer's palms and fingertips captured according to an embodiment of the present invention.

[0022] FIG. 21 show an image of a print pattern of left and right hand prints taken during different scans and captured according to an embodiment of the present invention.

[0023] FIG. 22 shows an exemplary image including hand print data and calibration data according to an embodiment of the present invention.

[0024] FIG. 23 shows a flowchart depicting a method of capturing hand print and calibration data according to an embodiment of the present invention.

[0025] FIG. 24 shows a flowchart depicting a method of capturing hand print data according to an embodiment of the present invention.

[0026] FIG. 25 shows a prism and scanning imaging system according to an embodiment of the present invention.

[0027] The present invention will now be described with reference to the accompanying drawings. In the drawings, like reference numbers can indicate identical or functionally similar elements. Additionally, the left-most digit(s) of a reference number may identify the drawing in which the reference number first appears.

DETAILED DESCRIPTION OF THE INVENTION

[0028] Embodiments of the present invention provide a method for scanning all or part of a hand print for one or more hands positioned on a non-planar surface of an optical element. The non-planar surface can be symmetrical about an axis of symmetry of the optical element. Typically, a palm pocket, writer's palm, or the like, is hard to capture on a flat surface. In contrast, the non-planar surface of the present invention provides a form so that the palm pocket, writer's palm, or the like, can be captured. Hand and/or finger characteristic data can also be captured, for example hand geometry (e.g., finger lengths and spacing between fingers).

[0029] The non-planar prism can also include an alignment device (e.g., a hand-locating feature) than can be used to position a hand based on a point between a thumb and an index finger, between any other two fingers, a full hand on one side of the alignment device, both hands with each hand on either side of the alignment device, or to capture writer's palm and/or writer's palm and fingertip images.

Terminology

[0030] To more clearly delineate the present invention, an effort is made throughout the specification to adhere to the following term definitions consistently.

[0031] The term "finger" refers to any digit on a hand including, but not limited to, a thumb, an index finger, middle finger, ring finger, or a pinky finger.

[0032] The term "print" can be any type of print including, but not limited to, a print of all or part of one or more fingers, palms, toes, foot, hand, etc. A print can also be a rolled print, a flat print, or a slap print.

[0033] The term "hand print," as used herein according to the present invention, can include any region on a hand having a print pattern, including thenar and hypothenar regions of the palm, interdigital regions, palm heel, palm pocket, writer's palm, and/or fingertips.

[0034] The term "biometric data" or "biometric information" throughout the specification can be data representative of a biometric, a digital or other image of a biometric (e.g., raw image data, a bitmap, binary, or other file), extracted digital or other information relating to the biometric (such as minutiae), etc.

[0035] The term "live scan" refers to a capture of any type of print image made by a print scanner.

[0036] A platen can be movable or stationary depending upon the particular type of scanner and the type of print being captured by the scanner.

[0037] The terms "biometric imaging system," "scanner," "live scanner," "live print scanner," "fingerprint scanner," and "print scanner" are used interchangeably, and refer to any type of scanner which can obtain an image of a print pattern on all or part of one or more fingers, palms, toes, foot, hand, etc. in a live scan. The obtained images can be combined in any format including, but not limited to, an FBI, state, or international tenprint format.

[0038] The terms "finger characteristic information" and "hand characteristics information" are used to describe hand geometry information, such as finger and thumb lengths and spacing and minutiae extracted from print information.

[0039] The term "non-planar prism" includes a prism having a non-planar platen surface that extends around all or part of an axis of the prism, and whose non-planar platen surface allows for total internal reflection of light. A non-planar platen surface allows a print pattern (such as, a print pattern on a hand, a palm pocket, a writer's palm, a writer's palm with fingertips), or other hand characteristic images, to be captured. An example of this type of prism can be an approximately conically-shaped prism. Other examples can be approximately spherically shaped prisms, curved prisms, and the like.

Overall System

[0040] FIG. 1 shows a system 100 for capturing image data representing biometric data according to an embodiment of the present invention. System 100 includes a local section or unit 102 and a remote section or unit 104 (e.g., a computer, or the like) that can be coupled via a network 106. Network 106 can be any type of network or combination of networks known in the art, such as a packet-switched network with wired or wireless links, an intranet, the Internet, an Ethernet, or the like. Example links are links having a FIREWIRE or USB network interface. The remote section 104 may be in a same area as the local section 102, such that local and remote refer to an approximate distance they are relative to a final processing device of the image data (e.g., print or hand characteristic data).

[0041] Local section 102 includes a non-planar prism 108, having a non-planar (e.g., curved) surface that is symmetrical about an axis of symmetry of the prism, positioned between a light source 110 and a scanning imaging system 112. Scanning imaging system 112 can include a rotating imaging system 114 and a detecting system 116 (e.g., a camera). Scanning imaging system 112 captures images or image data from parts of a hand (not shown) interacting with non-planar prism 108. The image data is processed in processing and control system 118, which can generate one or both of an output signal and a communications signal, which can include the image data. The output signal can be transmitted to an optional output device 120, while the communications signal can be transmitted to input/output (I/O) device 122. The I/O device 122 then sends the output signal to remote section 104 over network(s) 106.

[0042] It is to be appreciated that in other embodiments scanning imaging system 112 can include a stationary lens sized to capture all light leaving non-planar prism 108 that has been totally internally reflected from a section of the non-planar prism 108 proximate an area in which a person (not shown)

interacts with the non-planar prism 108 and a stationary large area array sensor.

[0043] Remote section 104 includes an I/O device 124, a processing system 126, and optionally an output device 128. Processing system 126 can be used to process the image data to generate biometric data. For example, extraction and matching operations can be performed on the image data. Once completed, results can be displayed or audibly indicated using output device 128. It is to be appreciated that other processes known in the biometric arts can also be performed in remote section 104. All of these additional processes are contemplated within the scope of the present invention.

[0044] It is to be appreciated that network 106 and/or remote device 104 can be coupled to other peripheral devices and/or networks, which is contemplated within the scope of the present invention.

[0045] FIG. 2 shows local section 102 of system 100 according to an embodiment of the present invention. Rotating imaging system 114 can include a motor 200, belt 202, and pulley 204 that rotates rotating stage 206, optical enclosure 208, and detecting system 116 around an axis of symmetry of non-planar prism 108. During rotation, positioning of rotating imaging system 114 can be monitored by controller 118 using signals from stop position sensor 210, home position sensor 212, and/or encoder system 214. In this example, encoder system 214 is an optical position encoder receiving light on sensor 216 after the light interacts with strip 218.

[0046] Although certain dimensions and/or types of devices are shown in this figure, these are not meant to be limiting, only exemplary. It is to be appreciated that different sizes or types of elements can be used within the scope of the present invention.

[0047] It is to be appreciated that, although not shown, various other types of devices can be used to rotate rotating imaging system 114. For example, an electromagnetic device (e.g., stepper motor), a resilient device, or any other device known to one or ordinary skill in the art are all contemplated within the

scope of the present invention. Thus, a motor/belt/pulley system is shown merely as one exemplary way to rotate rotating optical system 114.

[0048] Exemplary aspects of system 100 can be found in U.S. Ser. Nos. 10/___,___, entitled "System For Obtaining Print And Other Hand Characteristic Information Using A Non-Planar Prism," and 10/___,___, entitled "System Having A Rotating Optical System And A Non-Planar Prism That Are Used To Obtain Print And Other Hand Characteristic Information," filed herewith, (Atty. Ref. Nos. 1823.0820002 and 1823.0820004), which are both incorporated herein by reference in their entireties.

Non-Planar Prism

[0049] FIG. 3 shows a cross-sectional view of non-planar prism 108 according to one embodiment of the present invention. Non-planar prism 108 has an opening 300 running along an axis of symmetry 302. Opening 300 is defined within an area 304 of non-planar prism 108 that has a non-planar first section 310 and a substantially planar second section 312. A top portion of non-planar prism 108 can contain a guide or positioning device 314, which is used to properly place a subject's hand (see FIGS. 15-16) during biometric image capture.

[0050] Non-planar prism 108 can be manufactured from transparent, translucent, and/or colored acrylic, glass, plastic, or the like, and may be coated with various protective coatings, as is known in the relevant arts. If the non-planar prism material is colored, it can be of a color that matches a color of light for a light source being used. A first surface 306 of first section 310 is shaped so as to provide the non-planar aspect to prism 108. As discussed above, the non-planar shape is preferably approximately conical, but can also be curved, spherical, or the like, so long as a second surface 316 provides total internal reflection of incident light.

[0051] Platen surface 306 is a surface upon which an object (e.g., a hand(s)) having a print is placed. Platen surface 306 can be a surface of non-planar prism 108 or another surface in optical contact with an outside surface of prism 108. For example, platen surface 306 can be a surface of an optical protective layer (e.g., silicone pad) placed on prism 108 at section 310.

[0052] FIG. 25 shows light leaving prism 108, which is received at detector 116 via rotating imaging system 114. During operation, the subject's hand is positioned using positioning device 314 (see FIGS. 15-16). Light enters non-planar prism 108 either from within opening 300 or from an edge 318 of opening 300. The light totally internally reflects from second surface 316 out second section 312 through rotating imaging system 114 onto detector 116. Examples of other image capturing configurations are found in U.S. Ser. No. 10/___,___, entitled "System Having A Rotating Optical System And A Non-Planar Prism That Are Used To Obtain Print And Other Hand Characteristic Information," filed herewith, (Atty. Doc. No. 1823.0820004), which is incorporated by reference herein in its entirety.

[0053] Through use of the shape shown for non-planar prism 108, substantially all or part of a hand (e.g., thenar and/or hypothenar region of the palm, the "writer's palm," inter digital regions, palm heel, palm pocket, and/or fingertips) (see FIGS. 17-21) can be captured in one or more scans. This is partially because a surface area of section 310 is sized to receive one or more hands wrapped around non-planar prism 108 generally along a direction of a curve. Accordingly, in one embodiment, images with features of up to two hands of a subject can be captured in a single scan.

[0054] FIGS. 4-5 show possible dimensions for non-planar prism 108 according to an embodiment of the present invention. In this example, non-planar prism 108 is approximately a 45 degree by 45 degree by 90 degree non-planar prism, with respect to opening 300. Other angles can be used as long as total internal reflection is maintained to allow capture of print images. Also, in this example, a diameter D1 of opening 300, a diameter D2 of positioning

device 314, and a diameter D3 of non-planar prism 108 are shown in FIG. 5. These diameters are exemplary, and not intended to limit the invention in any way. It is to be appreciated that other dimensions for these diameters could also be used (e.g., larger or smaller).

[0055] FIGS. 6-8 show stages of surface 600 of non-planar prism 108 when surface 600 undergoes a smoothing process.

[0056] In FIG. 6, surface 600 is shown after receiving a machine finish. It is to be appreciated that this figure is not drawn to scale. The roughness of surface 600 is exaggerated for purposes of illustration. The machine finish can be achieved using a mill, a lathe, a shaper, a machine tool, a human tool, a cast, a grinder, a polisher, or the like. These tools usually leave surface 600 with the machine finish. A certain roughness can occur at a machine finish of less than 32 micro inches root mean square. Another finishing method can be to use a diamond turned surface device, which leaves surface 600 closer to optical quality finish. Typically, the machine finish may appear and feel smooth, but it can be orders of magnitudes away from being an optical quality finish. For example, the machine finish can have valleys and grooves of about 16 micro inches, while optical quality is typically measured in wavelengths of light.

[0057] In FIG. 7, a protective refractive index matched coating 700 can be applied over the machine finish. The coating 700 can be transparent and have a viscosity that allows it to flow into and fill rough contours of surface 600 to obtain a high quality optical finish. The coating 700 can be applied through various techniques (e.g., dipping, spinning, vapor deposition, sputter deposition, spraying, etc.). The technique chosen can vary based on a type of coating material used, its viscosity, and its curing requirements. In some cases, dielectric materials in the coating can retain a large electrostatic charge, which is known to attract and retain undesirable particles of dust, dirt, and other foreign materials. The addition of an optically clear, electrically

conductive material within coating 700 can be utilized to eliminate this problem.

[0058] In FIG. 8, surface 306 is shown as an optically finished surface. After the coating 700 is applied, excess coating can be removed. The remaining surface is cured (e.g., using air drying, UV radiation, heat, or the like).

[0059] Use of coating 700 can facilitate the application of an optical target (see element 2292 in FIG. 22) on surface 306 of non-planar prism 108. Target 2292 may be applied by a variety of techniques (e.g., silk screening, stamping, photo transfer, laser engraving, mechanical engraving, etc.). Target 2292 can be a calibration target or other information desired in a particular application. Coating 700 can also provide protection of the prism surface from mechanical damage.

[0060] FIGS. 9-11 show a side, bottom perspective, and top perspective view, respectively, of non-planar prism 108, according to various embodiments of the present invention. These figures also show, although not to scale, scan sections 900 (e.g., radial scan line images) that can occur during scanning of a subject's hand (or hands). For example, as described above, scanning image capture system 112 can take images at each scan section 900 that are later processed to form a hand print image and/or used to determine print, finger, or hand characteristic information.

[0061] FIG. 9 includes opening 300 that includes opening edge 318 that can have a chamfered finish. For example, non-planar prism 108 can have a chamfered finish to edge 318 when configured for use with inside edge light sources. In contrast, as seen in FIG. 10, opening edge 318 can be squared, which is used for light sources that are inserted into section 300. Although not shown, a non-planar prism 108 can have an outside edge that is chamfered, which can be used with an outside edge light source. Still other configurations of non-planar prism 108 can be used to comply with other light source positions, which are all contemplated within the scope of the present invention.

[0062] FIGS. 12-13 show non-planar prisms 1200 and 1300, respectively, according to various other embodiments of the present invention. In FIGS. 12 and 13, non-planar prisms 1200 and 1300 are formed from coupling sections 1202-n and 1302-n together, where n is an integer (shown as n=1 and n=2 in the figures). It is to be appreciated that in an embodiment in which n approaches infinity (e.g., possibly 1000 planar sections 1202 or 1302 per inch), an outer surface of prism 1200 and 1300 can appear and feel smooth, similar to prism 108. This is in contrast to other embodiments discussed above and below in which non-planar prism 108 is made from a unitary piece of material and not a plurality of pieces coupled together.

[0063] Prisms 1200 and 1300 shown in FIGS. 12-13 also have first and second non-planar sections 1204/1206 and 1304/1306, in contrast to only one non-planar section in prism 108 in previous configurations. Thus, both top 1204 or 1304 and bottom 1206 and 1306 portions of prisms 1200 and 1300 in FIGS. 12 and 13 have non-planar surfaces, which is in contrast to prism 108 that has a planar base.

[0064] Sections 1202 and 1302 are discrete, planar sections that, when coupled together, form multi-faceted portions of prisms 1200 and 1300. This is in contrast to prism 108 that may be unitary and have a smooth contour and a circular circumference. Although shown with a certain number of sections 1202 and 1302, other numbers of sections 1202 and 1302 can also be used without departing from the scope of the present invention.

[0065] FIG. 14 shows a non-planar prism 1400 according to an embodiment of the present invention. Non-planar prism 1400 has a same general shape as non-planar prism 108, except it contains a cavity 1402 that can be filled with a liquid, fluid, gel, solid, or gas medium or material 1404. The medium or material 1404 can be chosen so that is has a similar or substantially same refractive index as non-planar prism surface 1406, although having a different refractive index is also contemplated within the scope of the present invention. A closing device 1408 (e.g., a cap) can be used to seal cavity 1402.

[0066] FIGS. 15-16 illustrate how a subject places one hand 1500 or both hands 1600 on a non-planar prism (e.g., prism 108). As can be seen, positioning device 914 in used is either case to properly align the hand 1500 or hands 1600 on non-planar prism 108 for image capture. This is also true when a positioning device of prisms 1200, 1300, or 1400 is used.

[0067] Although not shown in this figure, it is to be appreciated that a subject can also place an entire hand 1500 on either side of the positioning device 314 in order to capture both hands 1600 in a single scan. Using a non-planar prism allows for all portion of a hand 1500 or hands 1600, including a palm pocket, to be captured, as shown in FIG. 21.

[0068] Further, although not specifically shown in FIGS. 15 and 16, a subject can place one or both hands on non-planar prism 108 writer's palm side down on platen surface 306 so as to capture a writer's palm. Also, a subject can place one or more writer's palms and fingertips down to capture an image of a writer's palm and fingertips in a single scan, see FIG. 22.

Captured Hand Sections

[0069] FIGS. 17-22 show examples of various aspects of a hand or palm that can be imaged in order to generate biometric information or data. These are merely exemplary areas of a hand or palm. Other areas can be imaged, as would be obvious to one or ordinary skill in the art upon reading this description. These examples are not meant to limit the invention.

[0070] FIG. 17 shows sections 1702-1714 of a palm 1700 of a hand 1716 that can be imaged, according to embodiments of the present invention. Section 1702 is a first interdigital area. Section 1704 is a second interdigital area. Section 1706 is a third interdigital area. Section 1708 is a fourth interdigital area. Section 1710 is a thenar area. Section 1712 is a hypothenar area. Section 1714 is a central area or palm pocket.

[0071] FIG. 18 shows creases 1800-1804 of palm 1700 that can be included in an image, according to embodiments of the present invention. Crease 1800 is a thenar crease. Crease 1802 is a proximal transverse crease. Crease 1804 is a distal transverse crease.

[0072] FIG. 19 shows a writer's palm or writer's palm hypothenar area 1900 of palm 1700. Writer's Palm 1900 includes a print pattern (ridges and valleys) that extends from palm hypothenar area 1712 up along a side of the hand.

[0073] FIG. 20 shows images 2000 of right (R) and left (L) hand writer's palms 1900 and fingertips 2002, according to an embodiment of the present invention.

[0074] According to a feature of the present invention, writer's palm 1900 and fingertips 2002 can be captured in a single scan because of the shape of non-planar prism 108. Unlike conventional planar platen surfaces, writer's palm 1900 and fingertips 2002 can be placed on a non-planar prism 108 at the same time during a live scan without requiring any difficult or awkward contortions of a persons hand.

[0075] FIG. 21 shows images 2100 of right and left hand prints captured during two scans of scanner 112 according to an embodiment of the present invention.

[0076] FIG. 22 shows an exemplary image 2200 including image data of both a hand print and/or hand characteristic information 2290 and calibration data 2292. This can include any print information described above, including writer's palm and/or writer's palm and fingertip information. This may produce more readily admissible evidence under the Federal Rules of Evidence based on capturing and storing together the calibration data and the image data.

[0077] Capturing calibration data can be used to reproduce substantially exactly the image as originally captured. This is especially helpful as data is achieved and subsequently accessed at different times by different systems and applications. Such systems and applications can access both the image data

and calibration data in an original scan to enable successful, high-quality reproduction or analysis of the captured image data with appropriate calibration. Also, calibration data can be used to ensure system 100 is calibrated to capture a consistent and accurate image 2200. For example, system 100 can be calibrated each time scanning system 112 scans calibration data on non-planar prism 108.

Method of Capturing Print and Image Information

[0078] FIG. 23 shows a flowchart depicting a method 2300 of capturing hand print, hand characteristic information, and calibration data according to an embodiment of the present invention. In step 2302, image data representing biometric and/or hand characteristic data of a user interacting with a non-planar prism is captured. In step 2304, calibration data associated with the non-planar prism is captured. In step 2306, image information is generated that can include both the captured image data and the captured calibration data. In step 2308, the image information is stored.

Method of Capturing Palm Print

[0079] FIG. 24 shows a flowchart depicting a method 2400 of capturing hand print data and hand characteristic information (e.g., hand geometry and spacing information) according to an embodiment of the present invention. In step 2402, a hand is received on a non-planar prism 108. In step 2404, the hand is scanned to capture palm print data and fingerprint data. In one embodiment, hand characteristic information is also captured. In step 2406, correlation data is generated based on characteristics of the captured palm print and fingerprint data. In step 2412, the hand print data and hand characteristic information is stored.

[0080] It is to be appreciated that according to an embodiment of the present invention a quality check on the captured image data can be performed before storing the data. For example, a contrast, color, brightness, sharpness, etc. can be determined and compared to a threshold overall or individual value. In optional step 2408, a quality check is performed on the captured palm print and fingerprint data. In optional step 2410, a determination is made whether the quality check was successful. If yes, at step 2412, the biometric data is stored. If no, steps 2404-2410 are repeated.

[0081] In yet another embodiment, both hands of a subject can be captured at substantially a same time and the image can be processed similar to above.

[0082] U.S. Ser. Nos. 10/___,___, entitled "Biometric System For Capturing Print Information Using A Coordinate Conversion Method," and 10/___,___ entitled "System And Method For Generating A Preview Display In A Print Capturing System Using A Non-Planar Prism" (Atty. Doc. Nos. 1823.0820006 and 1823.082000A), which are both filed herewith, and which are both incorporated herein by reference in their entireties.

[0083] As described above, the non-planar surface of the non-planar prism allows for a pocket of a palm of hand to make contact with a platen and break a surface total internal reflection of the non-planar prism. This creates a mechanism for capturing a high contrast round palm print image. According to further embodiments, a print image can also be captured that includes both a palm print and one or more fingerprints on a same hand. In this way, other biometric information can be extracted from the print images, such as, the association of the palm and fingerprints as belonging to the same hand, distance information on the distance from palm locations to finger locations, etc. According to still further embodiments, both a hand print and target/calibration information can be captured at a same time and stored together.

Conclusion

[0084] While various embodiments of the present invention have been described above, it should be understood that they have been presented by way of example only, and not limitation. It will be apparent to persons skilled in the relevant art that various changes in form and detail can be made therein without departing from the spirit and scope of the invention. Thus, the breadth and scope of the present invention should not be limited by any of the above-described exemplary embodiments, but should be defined only in accordance with the following claims and their equivalents.